## ABSTRACT OF THE DISCLOSURE

A method for depositing metal layers on semiconductor substrates by a thermal chemical vapor deposition (TCVD) process includes introducing a process gas containing a metal carbonyl precursor in a process chamber and depositing a metal layer on a substrate. The TCVD process utilizes a short residence time for the gaseous species in the processing zone above the substrate to form a low-resistivity metal layer. In one embodiment of the invention, the metal carbonyl precursor can be selected from at least one of $W(CO)_6$, $Ni(CO)_4$, $Mo(CO)_6$, $Co_2(CO)_8$, $Rh_4(CO)_{12}$, $Re_2(CO)_{10}$, $Cr(CO)_6$, and $Ru_3(CO)_{12}$ precursors. In another embodiment of the invention, a method is provided for depositing low-resistivity W layers at substrate temperatures below about 500° C, by utilizing a residence time less than about 120 msec.